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ABSTRACT

This guide is designed for use by school counselors and students (especially in Virginia), working with parents and teachers to investigate career and educational opportunities. It presents apprenticeship as a beneficial option for high school students, based on four trends: (1) a global economy, advancing technology, and increased competition in the job market require a work force more skillful in mathematics, science, and communication than ever before; (2) most new jobs require education beyond high school but less than a bachelor's degree; (3) the cost of education beyond high school continues to increase each year; and (4) apprenticeable occupations exist in most technical and professional fields. This guide describes four career areas in which apprentices may learn skilled occupations in combined on-the-job training and related classroom instruction: manufacturing and production, building and construction, mechanical and technical occupations, and service occupations. An overview of each of these career areas describes the general working conditions, average earnings of workers in those occupations, and sources of additional information. Following the overview, specific apprenticeable occupations are described in more detail. The guide includes 5 sources for more information. Contains 17 references. (KC)

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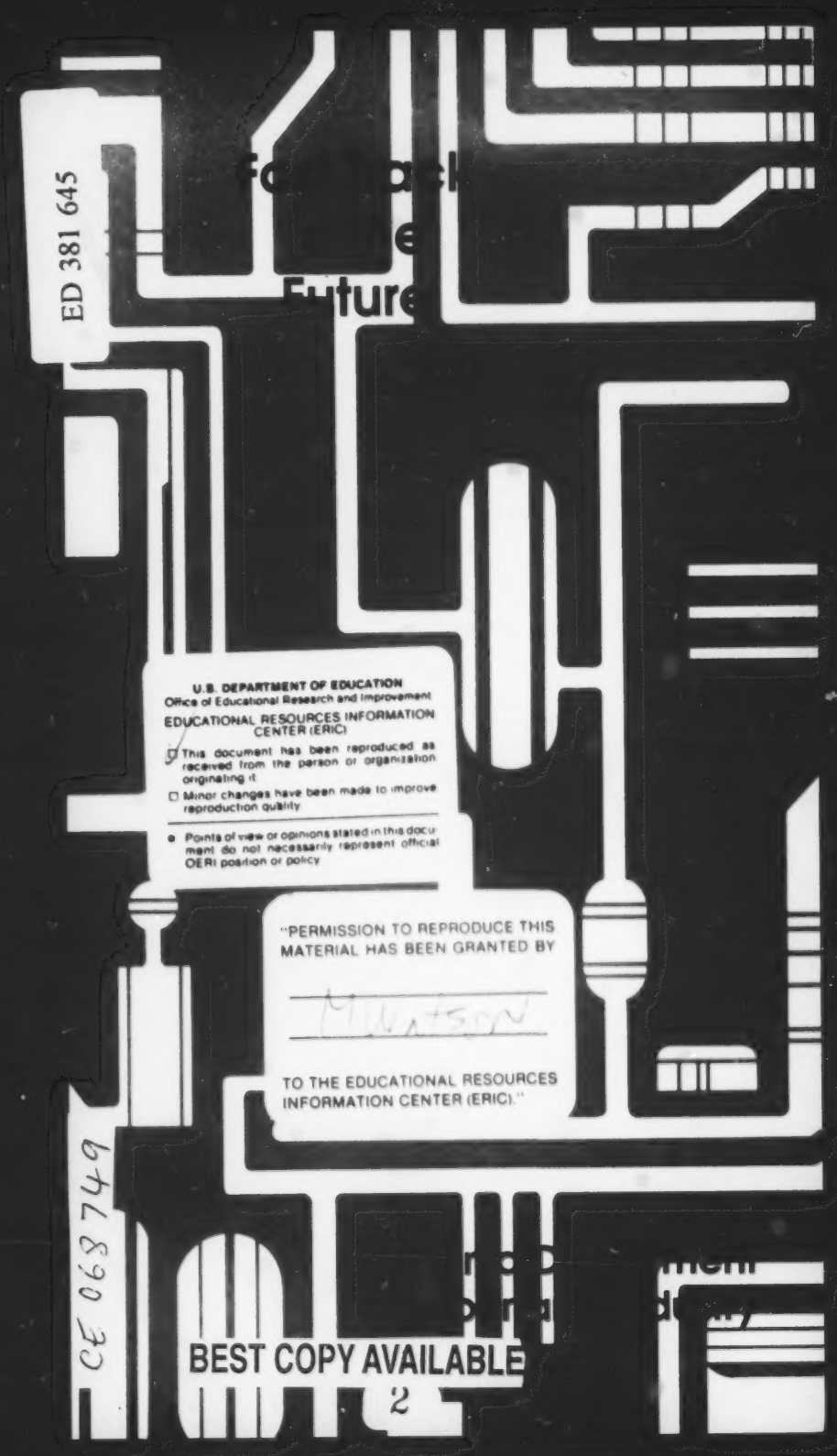
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APPRENTICESHIP
FAST TRACK TO THE FUTURE

Developed by
Virginia Department of Labor and Industry
Apprenticeship Training
13 South 13th Street
Richmond, Virginia 23219

and
Virginia Vocational Curriculum and Resource Center
2200 Mountain Road
Glen Allen, Virginia 23060

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DEDICATION

Apprenticeship: Fast Track to the Future is dedicated to Teresa Anne Sigafoose, Apprenticeship Supervisor, Virginia Department of Labor and Industry, whose vision and influence helped shape the Viginia student apprenticeship program.

1938 - 1992

PREFACE

Apprenticeship: Fast Track to the Future is designed for use by school counselors and students, working together with parents and teachers to investigate career and educational opportunities. It presents apprenticeship as a beneficial option for high school students, based on four trends:

- A global economy, advancing technology, and increased competition in the job market require a workforce more skillful in math, science, and communication than ever before.
- Most new jobs require education beyond high school but less than a bachelor's degree.
- The cost of education beyond high school continues to increase each year.
- Apprenticeable occupations exist in most technical and professional fields.

This catalog describes four career areas in which apprentices may learn skilled occupations in combined on-the-job training and related classroom instruction:

- manufacturing and production
- building and construction
- mechanical and technical
- service.

An overview of each career area describes the general working conditions, average earnings of workers in those occupations, and sources of additional information. Following the overview, specific apprenticeable occupations are described in more detail.

Accompanying the catalog are unbound, one-page job descriptions that include tasks learned by apprentices on the job and concepts and tasks learned in the classroom or lab in related instruction. Counselors may duplicate these pages for distribution to students, other school personnel, parents, and interested members of the community.

Please direct questions or comments to the Department of Labor and Industry, Apprenticeship Division, (804) 786-2381.

ACKNOWLEDGMENTS

This catalog was developed in a joint venture by the Virginia Department of Labor and Industry and the Virginia Vocational Curriculum and Resource Center to publicize apprenticeship as a highly beneficial partnership between Virginia employers and workers in training. The developers gratefully acknowledge the following businesses and organizations for their generous financial contributions to the project:

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Virginia Merit Shop Education Foundation, Inc., Alexandria
WESTVACO, Bleached Board Division, Covington.

The following apprentices, journey workers, supervisors, and instructors graciously allowed the developers to photograph and interview them.

From DuPont, Waynesboro (photographed at Valley Vocational-Technical Center, Fishersville):

Charles E. Bedall, instructor
Richard A. Black, apprentice
Larry N. Breeden, apprentice
Donald P. Clatterbaugh, apprentice
Donald W. Coffey, apprentice
Danny Cork, apprentice

Wiley J. Craig, apprenticeship coordinator, Valley Vo-Tech
Sterling Durrett, instructor
Frederick W. Fitzgerald Jr., apprentice
Ronald D. Hanger, apprentice
John L. Huffer, instructor
Calvin W. Hughes, apprentice
Larry E. Long, instructor
Earl A. Riddle, apprentice
Joe B. Rutledge, apprentice
Curtis L. Smith, apprentice
Robert F. Smith Jr., apprentice
William M. Smith, apprentice
Rodger Lee Turner, apprentice

From Ironworkers Local 28, Richmond:
Robert Harmon, journey worker
Kathy Ramos, apprentice
Catherine A. Renn, journey worker
G. G. Renn, journey worker
Louis J. Wright, supervisor

From Jewett Machine, Richmond:
Justin Alexander, apprentice
John D. Beasley, apprentice
Herman Cooke, plant manager
William Englehurt Jr., team leader
Mike Fitzgerald, journey worker
John Livingston, apprentice
Alan Pitt, technician

From Lewis Construction, Richmond:
Walter R. Martin, supervisor
Michael G. Williams, apprentice

From LensCrafters, Richmond:
Arlinda Baylor, apprentice
Donna L. Middleton, apprentice
Mildred Schultz, supervisor

From Merck Pharmaceuticals, Elkton:
James Hammer, technician
Sara Kisling, technician
Thomas J. Hughes, training manager

From Tobacco Company Restaurant, Richmond
Mark W. Kimmel, chef and apprentice supervisor
Regina B. Lowery, apprentice
Marco C. Shaw, apprentice

From William Byrd Press, Richmond:
Douglas Fleming, apprentice
Shelia D. Johnson, apprentice
Charles B. Jones, training manager.

Development of the catalog was coordinated by the staff of the Virginia Department of Labor and Industry:
Dr. Thomas E. Butler, Assistant Commissioner
Robert Baumgardner, Director, Apprenticeship Division
George Eanes, Director, Apprenticeship Related Instruction
Harry Seay, Apprenticeship Supervisor.

Terri Marshall, Coordinator or the Richmond Apprenticeship and Workforce Information Center, Virginia Employment Commission, supplied valuable information and insight.

The catalog was designed, written, and produced by the Virginia Vocational Curriculum and Resource Center (VVCRC), a grant project of the Virginia Department of Education administered by Henrico County Public Schools, Department of Secondary and Adult Education:
Margaret L. Watson, Director
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Teresa P. Kieper, Publications Assistant.

The photograph of W. R. Phillips on page 9 was provided by Newport News Shipbuilding. The photograph of electrician apprentices Mike Scull and Mike Gault on page 27 was provided by Hampton Roads Joint Apprenticeship and Training Committee of the Electrical Industry.

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A NOTE TO SCHOOL COUNSELORS

This catalog is designed to encourage high school students to consider apprenticeship as a beneficial option for postsecondary occupational education. The benefits of apprenticeship reflect current and future trends in state and national economic activity and labor market demands.

- 70% of future jobs will require education beyond high school but not a baccalaureate degree. The escalating cost of college tuition makes alternative methods of occupational training very attractive.
- The level of communication and math skills required for these professional and technical jobs is increasing rapidly.
- The number of expert craft workers—practitioners of skilled trades such as masonry and precision machining—is declining. The demand for qualified workers is much greater than the supply. Apprenticeship is one of the best ways these experts can pass on their tradition of excellence and pride in work. Experts agree that America must regain its superiority in the skilled trades in order to compete in a global economy.
- Employers demand workers who can collaborate with others, solve problems, adapt to changing conditions, and manage their own jobs and lives outside of work. Student apprenticeship—part-time work as a registered apprentice while in high school—is an excellent way to gain these workplace skills. Cooperative education has long proved the value of adults as role models for working students.
- The fastest growing occupations will be in executive, managerial, professional, and technical fields, all requiring the highest levels of education and skill. The biggest growth in numbers will take place in service industries and occupations. There are apprenticeable occupations in almost all of these fields.

The Virginia Apprenticeship Act allows for apprenticeship to begin at age 16 in most skilled trades. However, Virginia child labor laws do place some restrictions on employment within certain occupations. Consult the Labor Law Division of the Department of Labor and Industry (804-786-2386) for further information.

The minimum level of education required for entry into apprenticeship varies. Most programs require entrants to have a high school diploma or equivalent. However, regardless of the level of education required, apprentices need a firm grounding in reading, writing, and mathematics—all basic to skilled occupations. Courses in algebra, geometry, trigonometry, drafting, physics, and other courses related to the technical and mechanical occupations are also highly recommended.

The educational attainment of apprentices has been climbing. Unable to find suitable jobs in their own fields, college graduates have turned increasingly to the skilled occupations for work. This movement may put the high school graduate at a disadvantage when competing for apprenticeship openings. Employers may choose college graduates because of a perceived potential for management. However, the high school graduate with relevant vocational background will usually make a favorable impression. Also, some employers prefer high school graduates because these workers are more apt to make a skilled trade their lifetime vocation.

Students should be cautioned that some of the more popular apprenticeship programs may have a waiting list.

TECH PREP

Tech prep is a systematic program of study that begins in grade 11 and culminates with an associate degree from a community college. All Virginia community colleges, along with cooperating school divisions in their service regions, are developing tech prep programs for non-baccalaureate-bound students. Because apprenticeship-related instruction may be delivered by a community college, it is possible for a student apprentice to begin working part-time in high school, work full-time after graduation, and earn an associate degree—in machine technology, for example—along with certification as a journey-level machinist or tool and die maker.

Students should be encouraged to investigate the possibilities of tech prep and an associate degree as a logical outgrowth of apprenticeship. To find out more about tech prep and apprenticeship, contact the Virginia Department of Labor and Industry, Division of Apprenticeship Training, or the tech prep coordinator for the Virginia Community College System.

WOMEN IN APPRENTICESHIP

Women today are assuming jobs traditionally held by men. Some of the most popular choices include auto mechanic, electrician, and carpenter.

Some out-of-school women, however, do not have the skills and knowledge in math or science to enter these lucrative careers. Either they were discouraged from taking these courses or they tried and failed to achieve passing grades. The result is a lack of confidence in their ability to learn.

Research by the American Association of University Women shows that female students often learn faster and more easily in one-on-one instruction or in small group, cooperative settings. Apprenticeship training, where on-the-job training is individualized and most related instruction classes are small, can offer women an excellent path to rewarding career opportunities.

All high school students, male and female, should be encouraged to take math, science, and vocational courses that will expand their opportunities for professional and technical careers. These courses can be interfaced with a tech prep program that directly involves apprenticeship training as the major focus of the program.

More information about women and opportunities for nontraditional employment is available from the Office of Gender Equity, Virginia Department of Education.

JOB DESCRIPTIONS

The jobs described in this catalog are also described on separate, unbound pages. These pages, which include information about related instruction as well as a list of job tasks and apprenticeship requirements, may be duplicated and distributed to students, parents, teachers, school administrators, and others.

ADDITIONAL RESOURCES

The following five Learning Activity Packages (LAPs) may be helpful to students, parents, or school staff interested in specific facets of apprenticeship:

- *Introducing Apprentices*
- *Selecting a Trade*
- *The Apprenticeship Classroom*
- *Apprentices in the Workplace*
- *Women in Apprenticeship.*

The LAPs are available from Fairfax County Schools, Adult and Community Education, Pimmit Hills Center, 7510 Lisle Avenue, Falls Church, VA 22043. They may be requested also from the Virginia Department of Labor and Industry. For copies of the LAPs and other information about apprenticeship, please call the Virginia Department of Labor and Industry, Apprenticeship Division at (804) 786-2381.

APPRENTICESHIP: FAST TRACK TO THE FUTURE

Have you ever pictured yourself

- controlling robots to make, repair, test, or ship products?
- making products for everyday use from recycled materials?
- building communities that blend with the environment?
- producing energy from renewable resources?
- building vehicles that will go faster, be safer, and cost less?
- helping people improve the quality of their lives?

If you have considered any of these possibilities, you should explore careers in production, construction, maintenance and repair, or service occupations.

Virginia employers need skilled workers in occupations ranging from auto body repairer to welder, from biomedical equipment technician to optician. They are willing to pay premium wages to workers who have "workplace know-how," or the ability to get the job done under highly demanding circumstances.

Because the demand from employers is high, the future looks bright for people who want to enter these careers. However, competition is tough.

How can you claim one of these careers? Consider apprenticeship: a system of combined on-the-job training and related classroom instruction that allows you to earn money while you learn.

Want to know more? Turn the page.

Sara Kisling and James Hammer repair a pH meter.

WHAT IS APPRENTICESHIP?

Apprenticeship is a training system under which a worker learns a skilled craft or trade while earning wages.

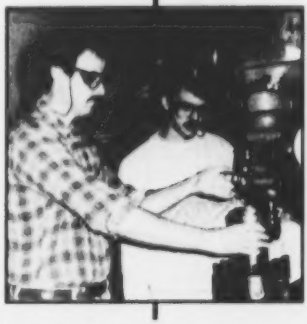
An apprenticeship program may be sponsored by an employer, an association of employers, a joint apprenticeship committee, or an organization of employees. The program must be registered with the Virginia Apprenticeship Council.

HOW does apprenticeship work?

- It is based upon a written training agreement between the apprentice and the employer.
- It consists of on-the-job training and classroom instruction on the theories and concepts related to the occupation.
- It ends when the apprentice completes the training, receives a Certificate of Completion, and is designated a journey-level worker.

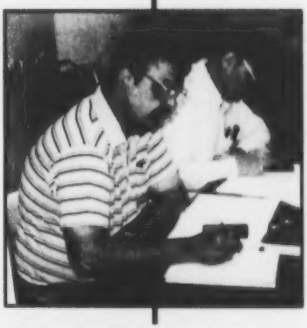
WHAT are the benefits of apprenticeship?

- Research shows that, compared to informally trained workers, apprenticeship graduates are more educated, work more steadily, learn their jobs faster, and are more likely to become supervisors. They are better skilled, more productive, and work more safely.[1]
- Apprentices earn while they learn. They generally start work at half the wage paid journey workers and receive regular raises throughout their



Team leader William Englehurt (l) helps Justin Alexander solve a problem.

[1]*Occupational Outlook Quarterly*. U.S. Bureau of Labor Statistics, Winter 1991/92, p. 28.



Apprenticeship can begin anytime after age 16: Both Donald Clatterbaugh and Frederick Fitzgerald have 20 years of work experience.

apprenticeship. According to the Virginia Employment Commission, these raises can mean a difference of $30,000 to an apprentice during a 4-year period when compared to the earnings of an unskilled worker. Apprentices work full time, averaging 40 hours a week, 50 weeks a year. For many, valuable benefits such as health care insurance and retirement are included.

- Apprenticeship teaches all aspects of a trade, thereby making workers more versatile.
- Apprentices learn to work with different kinds of people in an actual working situation. These "people skills" are highly valued by employers.

WHO is eligible for apprenticeship?

Most technical occupations require apprentices

- Δ to be at least 16 years of age
- Δ to have a solid foundation in math, science, and language
- Δ to have a high school diploma or GED or be working toward a high school diploma as a student apprentice
- Δ to be employed by a sponsoring employer.

Apprenticeship programs are open to both men and women and to all minorities.

HOW LONG does apprenticeship last?

The length of apprenticeship varies between one and six years, with four years of on-the-job training being the average. A certain number of related instruction classes are usually required for each year of apprenticeship.

WHAT ABOUT related instruction?

- Related classroom instruction usually takes place outside of work hours.
- Apprentices may attend class at technical schools, community colleges, or in industrial settings.
- Instructors are often expert journey-level workers.
- Classroom topics often include trade theory, math, science, and language. Concepts of psychology and economics are also taught. Additional language classes such as English as a Second Language are available in some areas of the state.
- Related instruction may also include hands-on practice of job tasks in a controlled, safe environment. Safe work practices are always taught.
- At the end of the required course of study, apprentices are awarded a certificate of completion. **An apprentice who maintains an A average and is nominated by his or her employer may earn an honors certificate.**
- The cost of related instruction is the responsibility of the apprentice. Employers may contribute to these expenses.
- Apprentices in an occupation that requires licensing are eligible to apply for the licensing exam when they have completed both their on-the-job training and related instruction.

W. R. Philips, Jr., President of Newport News Shipbuilding and former apprentice: "The education received by an apprentice student . . . builds confidence, and it provides the ability to adapt and be flexible."

WHO'S AN APPRENTICE?

Since 1938 when the state legislature passed the Voluntary Apprenticeship Act, Virginia workers have completed more than 40,000 apprenticeships. Although this catalog describes 31 of the most popular programs in the state, the U.S. Bureau of Apprenticeship and Training recognizes nearly 800 apprenticeable occupations, ranging from accordion maker and actor to winemaker and x-ray equipment tester. Many people are aware of apprenticeships in the construction and industrial environments. It is also possible to apprentice to be a firefighter, graphics designer, or jeweler.

The availability of apprenticeship programs depends primarily on the area of the country and the need for trained workers. For example, because there is little industry in Northern Virginia, most apprenticeships are in the construction field. The demand is entirely different in Tidewater Virginia, where many manufacturing and production opportunities exist.

As long ago as the Middle Ages, apprenticeship was the most common way for Europeans to learn a trade. Although the most glamorous example might involve the squire apprenticed to a knight, craft guilds sponsored a system in which youth were "indentured" to established craft workers. When Europeans emigrated to America, they brought with them the system and traditions of crafts and apprenticeship. Famous Americans who were once apprenticed include

- George Washington, surveyor
- Thomas Jefferson, nail maker

Justin Alexander, John Beasley, and John Livingston, shown here with team leader William Englehurt (l), are preparing for a rewarding career in precision machining.

- Δ Benjamin Franklin, printer
- Δ Paul Revere, silversmith
- Δ Abraham Lincoln, lawyer
- Δ Andrew Johnson, tailor.

Many of the skilled occupations that are currently apprenticeable in Virginia are described on the following pages. They are presented in clusters representing manufacturing, construction, maintenance/repair, and service occupations.

Manufacturing/Production Workers 13
Building and Construction Workers 23
Mechanics and Technicians . 33
Service and Support Workers 45

Regina Lowery and Marco Shaw are training for one of 800 apprenticeable occupations.

MANUFACTURING AND PRODUCTION WORKERS

Workers in production and manufacturing occupations make products from all kinds of materials, from paper and plastics to light metal alloys and iron. If you become an apprentice in one of these trades, you might make parts for machines, build ships, print newspapers and magazines, or produce clean water.

Like most heavy industry occupations, these jobs are becoming increasingly computer-aided. If you have an aptitude for computer-related tasks as well as an interest in highly technical math and science, the production and manufacturing field offers challenging and rewarding careers.

In Virginia, apprentices work in the following production occupations:

Machinist
Printing Press Operator
Sheet Metal Worker
Shipfitter
Tool and Die Maker
Wastewater Treatment Plant Operator
Welder.

Alan Pitt uses CAD to help design machine parts.

WORKING CONDITIONS

Most production workers work in clean, well lighted, and well ventilated shops. However, high-speed machines present hazards that demand strict attention to safety and the wearing of protective equipment. Some metals can emit toxic fumes as they melt. Some workers are exposed to chemicals and gases that can be harmful.

Production workers usually work a 40-hour week but overtime is common

during peak production times. Production shifts require night and weekend work.

Many manufacturing firms are organized around work teams. Workers make decisions and have responsibilities that used to belong to middle managers, so they must be skilled at working with people as well as machines. Concepts such as "just-in-time" and "zero defect" manufacturing mean that teams must respond quickly to changes and solve problems in a creative way.

JOB OUTLOOK

Herman Cooke, plant manager: "Master machinists are a dying breed. Unless we train our own apprentices, we're out of business."

With the exception of wastewater treatment plant operators, the national demand for production workers will stay the same or decline slightly through 2005. The primary need is to replace employees who are retiring or leaving the workforce. However, employers are currently having trouble finding applicants with the required mathematical and mechanical skills, so excellent opportunities exist for qualified apprentices.

The demand for wastewater treatment plant operators is expected to grow, although employment opportunities may shift from local government to private firms.

EARNINGS

Nationally, the median hourly wage for journey-level production and manufacturing workers in 1990 ranged from $10.07 for sheet metal workers to $13.92 for tool and die makers.

Apprentices start at about 40 to 50 percent of the wage of journey-level workers and receive periodic raises until they reach full pay.

ADDITIONAL INFORMATION

To find out more about production and manufacturing occupations and apprenticeship opportunities in the industry, contact the local Virginia Employment Commission Job Services Office; the Virginia Department of Labor and Industry, Division of Apprenticeship Training; or the U.S. Department of Labor, Bureau of Apprenticeship and Training. (See page 59 for addresses and telephone numbers.)

John Livingston followed his father into the machine trades.

MACHINIST

Machinists set up and operate conventional, special-purpose, and numerical control machines and machining centers to make and assemble parts for industrial machinery, aircraft, automobiles, and other manufactured goods. They may make one-of-a-kind or small batches of parts to order.

As part of their work, machinists

- Δ **determine** dimensions and tolerances, operational sequence, and setup requirements by studying blueprints, sketches, specifications, or samples
- Δ **measure and mark** dimensions and reference points on the work-piece as guides to future machining
- Δ **select, align, and secure** holding fixtures, cutting tools, or attachments on machines
- Δ **regulate** machining factors such as speed, feed, coolant flow, and depth and angle of cut
- Δ **adjust** machine controls as required
- Δ **verify** conformance of finished workpiece to specifications
- Δ **fit** parts into complete assembly
- Δ **verify** dimensions and alignment of assembly.

Justin Alexander says that his high school course in woodworking was valuable preparation for machinist apprenticeship.

BECOMING A MACHINIST

- Generally, machinist apprenticeships require 4 years on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school diploma and mechanical and mathematical aptitudes.
- Recommended secondary school courses include algebra, geometry, trigonometry, physics, drawing and design, and machine shop.

PRINTING PRESS OPERATOR

Printing press operators set up, operate, and maintain printing presses, performing duties that vary with the type and size of press. **Rotogravure presses** are used to print illustrations for the most part, and **web presses** are primarily used to print newspapers , books, and periodicals. Large in-line web presses may require several operators on each run.

Press operators may

- Δ **check** job order to find out the kinds of paper and colors of ink to be used
- Δ **load** the press with paper and ink
- Δ **start** the press and **monitor** its operation
- Δ **secure** printing plates to the printing unit and **adjust** the tolerances
- Δ **run** proofs and **make** adjustments
- Δ **adjust** control margins and ink flow to the inking rollers
- Δ **clean and oil** the press and make minor repairs
- Δ **clean and reset** rollers
- Δ **set up and operate** plate-making equipment and paper-cutting, drilling, and folding machines
- Δ **clean** ink fountains; **remove, clean, and store** plates; **clean** the printing unit cylinders at the end of the run.

Shelia Johnson prepares negatives for printing.

BECOMING A PRINTER

- Printer apprenticeship programs require 4 to 6 years of on-the-job training and related classroom instruction.
- Most employers prefer applicants with a high school education with a knowledge of grammar, math, chemistry, electronics, and physics.
- Printers need an ability to visualize color and good oral and written communication skills.
- Apprentices may begin by learning pre-press operations.

SHEET METAL WORKER

Sheet metal workers fabricate, assemble, install, and repair sheet metal products and equipment such as control boxes, duct work, drainpipes, ventilators, and furnace casings according to job orders or blueprints.

To accomplish a wide variety of jobs, sheet metal workers

- Δ **study** blueprints to learn size, location, and type of metal necessary for the job
- Δ **make** shop drawings from the blueprints to follow when constructing and assembling the needed sheet metal product
- Δ **layout** the metal sheet to show where it is to be cut
- Δ **set up and operate** fabricating machines to cut, bend, and straighten sheet metal
- Δ **cut and shape** the metal piece, using various tools and machines
- Δ **set up and operate** soldering and welding equipment to join metal parts
- Δ **smooth** seams, joints, or rough surfaces
- Δ **check** the finished parts for proper measurements
- Δ **install** assemblies in worksite according to blueprint specifications, using hand tools and power tools.

Bryan Rose fabricates metal parts using a CNC machine.

BECOMING A SHEET METAL WORKER

- Apprenticeship programs for sheet metal workers generally require 4 years of on-the-job training and related instruction.
- Employers prefer applicants with a high school diploma who have had secondary school courses in algebra, geometry, trigonometry, physics, mechanical drawing, and welding.

SHIPFITTER

Shipfitters lay out and fabricate the ship's metal structural parts, such as plates and frames, and brace them in position to be riveted or welded. As part of their job, they may

- Δ **lay out** position of parts on metal, working from blueprint or templates
- Δ **locate and mark** reference lines such as center, buttock, and frame lines
- Δ **position** parts in hull of ship, assisted by rigger
- Δ **align** parts in relation to each other, using jacks, turnbuckles, clips, wedges, and mauls
- Δ **mark** location of holes to be drilled and **install** temporary fasteners to hold part in place for welding or riveting
- Δ **install** packing, gaskets, liners, and structural accessories and members such as doors, hatches, brackets, and clips.
- Δ **prepare** molds and templates for fabrication of nonstandard parts
- Δ **tack weld** clips and brackets in place prior to permanent welding
- Δ **roll, bend, flange, cut, and shape** plates, beams, and other heavy metal parts.

BECOMING A SHIPFITTER

- Apprenticeship programs for shipfitters usually require 3 to 4 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school diploma.
- Secondary courses in algebra, geometry, trigonometry, machine shop, and mechanical drawing are helpful to apprentices.

Virginia employs many workers in the shipbuilding industry, primarily in the Tidewater and Hampton Roads areas of the state.

TOOL AND DIE MAKER

Tool and die makers construct, remodel, maintain, repair, and test metalworking dies (forms used in stamping and forging operations), cutting tools, fixtures (work-holding devices), jigs (fixtures that guide tools), gauges, and machinists' hand tools. They use many types of machine tools and precision measuring instruments. In shops that use numerically controlled machine tools, the tool and die makers may plan and write CNC programs.

Specifically, tool and die makers

- Δ **study** blueprints, sketches, models, or written specifications in order to picture the final product
- Δ **plan** the type of stock, layout, machining, and assembly operations needed to complete the job
- Δ **measure and mark** the proper stock for machining
- Δ **set up and operate** machine tools
- Δ **smooth and finish** the workpiece, using hand tools
- Δ **fit and fasten** parts together with bolts, screws, or dowels
- Δ **connect** any wiring or hydraulic parts.

Did you know?

Some metals are so light that they will change shape just by being held in the hand.

BECOMING A TOOL AND DIE MAKER

- Most tool and die maker apprenticeships require 4 or 5 years of on-the-job training and related classroom instruction.
- Employers generally prefer applicants with a high school education and a good working knowledge of algebra, geometry, trigonometry, and physics.
- Tool and die makers need good eyesight, a great amount of patience, and attention to detail.

WASTEWATER TREATMENT PLANT OPERATOR

Wastewater treatment plant operators tend pumps, conveyors, blowers, chlorinators, vacuum filters, and other equipment used to decontaminate domestic and industrial wastewater.

As part of their duties, treatment plant operators

- Δ **remove** obstructions from filtering screens to increase the flow of wastewater through the initial screening process
- Δ **adjust** valves to regulate the flow through settling tanks
- Δ **regulate** the amount of air and steam used to aerate the effluent and to control the temperature in sludge digestion tanks
- Δ **detect** equipment malfunctions and **determine** when lubrication of equipment or other periodic service is necessary by interpreting temperature gauges, charts, and flow meters
- Δ **collect** samples
- Δ **conduct** laboratory tests
- Δ **report** on tests or operations
- Δ **perform** minor maintenance.

Like other production processes, water treatment is becoming increasingly computer-aided.

BECOMING A WASTEWATER TREATMENT PLANT OPERATOR

- Apprenticeship programs for wastewater treatment plant operators require 3 to 4 years of on-the-job training and related classroom instruction.
- Most employers prefer applicants who have a high school education.
- Secondary school courses in chemistry, biology, physics, algebra, and shop mechanics are helpful to apprentices.

WELDER, COMBINATION

Welders permanently join pieces of metal with metal filler, using heat or pressure. Welders join parts being manufactured, build structures, and repair broken or cracked parts according to specifications. There are three major types of welding: arc, gas, and resistance. They differ in the manner in which heat is applied.

Welders

- Δ **identify** materials to be welded
- Δ **select** a suitable electrode (welding rod)
- Δ **select** the appropriate welding method
- Δ **adjust** the electric current on the power source according to the types of metals being welded
- Δ **strike** an arc by touching the electrode to the metal to be welded, completing an electric circuit
- Δ **guide** the arc, with its intense heat, along the edges of the metals to be joined, to make the weld
- Δ **use** a torch to cut metal
- Δ **perform** gas welding and burning.

BECOMING A WELDER

- It generally takes 3 years of on-the-job and classroom training to complete a welding apprenticeship program.
- Employers prefer applicants with a high school education.
- Secondary school courses in algebra, geometry, trigonometry, mechanical drawing, blueprint reading, technology education, machine shop, welding, and electricity/electronics help apprentice welders learn their trade.

John Huffer checks the progress made by apprentice Donald Coffey.

BUILDING AND CONSTRUCTION WORKERS

If you become an apprentice in a building and construction occupation, you may build houses, apartment buildings, sky-scraper office buildings, factories, schools, or shopping malls. However, you might also be involved in the construction of roads, bridges, railways, tunnels, airports, or parks.

In Virginia, apprentices work in the following construction occupations:

Brickmason/Stonemason
Carpenter
Electrician
Heating, Ventilation, Air Conditioning, and Refrigeration Technician
Plumber/Pipefitter
Structural Steel Worker
Surveyor Technician (Party Chief).

Journey-level ironworkers Catherine Renn and G. G. Renn are a father-daughter team. He was her apprenticeship supervisor.

WORKING CONDITIONS

Generally, construction occupations require workers to have physical strength, stamina, and manual dexterity. Much of the work takes place outdoors and is sometimes delayed because of weather. Construction workers must stand, kneel, or crouch, sometimes in tight places, to perform job tasks.

Construction workers must adhere strictly to safety rules to work effectively in high places, around electricity, and with high-speed equipment.

Some construction workers change employers with every job. Others work for contractors or alternate between contract work and self-employment on small jobs.

JOB OUTLOOK

Nationally, employment of most construction workers is expected to show moderate growth through 2005 in response to increased residential, commercial, and industrial construction. Employment of electricians will grow somewhat faster.

The construction industry responds to the economy; in times of economic growth, construction workers are in great demand. In addition to growth in the construction industry, employment opportunities will occur because many current workers are nearing retirement age and must be replaced.

Many women have found employment in the construction industry, especially as carpenters and electricians. Apprenticeship represents an excellent training method for women who wish to earn more than is offered in many traditionally female-dominated occupations.

Did you know?

The first minimum wage, established in 1938, was 25¢ per hour.

EARNINGS

Nationally, the median wage for journey-level construction workers in 1990 ranged from $10.30 per hour for brickmasons to $14.25 per hour for structural steel workers, whose earnings reflect the danger attached to their jobs.

Apprentices start at about 40 to 50 percent of the wage of journey-level workers and receive periodic raises until they reach a full wage.

ADDITIONAL INFORMATION

If you want to know more about construction occupations and apprenticeship opportunities in the industry, contact your local Virginia Employment Commission Job Services Office; the Virginia Department of Labor and Industry, Division of Apprenticeship Training; or the U.S. Department of Labor, Bureau of Apprenticeship and Training. (See page 59 for addresses and telephone numbers.)

BRICKMASON/STONEMASON

Brickmasons lay brick, stone, structural tile, marble, concrete blocks, and other masonry materials to build walls, partitions, fireplaces, and other structures. **Stonemasons** build stone structures such as piers and walls or lay walks, curbstones, or other special types of masonry.

Brick and stonemasons

- Δ **estimate** materials needed
- Δ **interpret** blueprints, sketches, and plans
- Δ **measure** distances from reference points and **make guidelines** on work surfaces to lay out work
- Δ **determine** the alignment of brick courses, using plumb bob, level, and line
- Δ **cut** bricks to size and **shape** stones before setting
- Δ **spread** mortar to serve as a base and binder for bricks and stones
- Δ **set** stone in place by hand or crane
- Δ **align** stone with a plumbline
- Δ **tap** bricks to align, level, and embed them in mortar
- Δ **finish** mortar joint between bricks and stones with a shaped tool.

Because of the number of materials and difficulty of techniques involved, brick and stonemasons continue to study even after their apprenticeship is over.

BECOMING A BRICKMASON OR STONEMASON

- Apprenticeships are usually sponsored by local contractors or joint apprenticeship committees.
- Apprenticeship programs generally require 3 years on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Recommended secondary courses include algebra, geometry, trigonometry, mechanical drawing, and carpentry or woodworking.

CARPENTER

Carpenters construct, erect, install, and repair structures made of wood and wood products, following local building codes. Jobs may range from constructing concrete forms and temporary frame shelters to projects that require exacting finish work.

To perform this wide range of duties, carpenters

- Δ **interpret** blueprints, sketches, and building plans
- Δ **order** building materials from blueprints
- Δ **select, measure, and lay out** cutting and assembly lines on materials
- Δ **cut and shape** materials to prescribed measurements, using hand and power tools
- Δ **assemble, fasten, and install** materials
- Δ **weld** metal parts to structural steel
- Δ **lay** floors and **build** stairs
- Δ **check** the accuracy of completed work with plumb bob and carpenter's level
- Δ **install** metal studs used for partition walls.

Michael Williams, carpenter apprentice, works outdoors on a cold, clear day.

BECOMING A CARPENTER

- Virginia has a large number of carpenter apprenticeship programs.
- Apprenticeship programs usually require 4 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Recommended secondary courses include algebra, geometry, carpentry, drawing and design, woodworking, electricity and electronics, metal shop, and technology education.

ELECTRICIAN

Electricians lay out, assemble, install, maintain, and test electrical power distribution systems, fixtures, control equipment, and wiring used in heating and refrigeration, lighting, power, intercommunication, air conditioning, and electrical systems.

To accomplish these duties, electricians

- Δ **detect** hazards, through observation and testing of installed equipment or systems, and **determine** adjustment, relocation, or replacement needs
- Δ **plan** installations consistent with specifications and local codes
- Δ **prepare** sketches or **follow** blueprints showing the location of wiring and equipment
- Δ **measure, cut, bend, thread, assemble, and install** electrical conduits
- Δ **pull** wires through conduit and **connect** them to lighting fixtures and power equipment
- Δ **install** switches, relays, and circuit breaker panels for control and distribution of electricity.
- Δ **connect** power cables to equipment and **install** ground leads
- Δ **test and observe** installed equipment or systems to ensure electrical compatibility and safety
- Δ **install** programmable controllers and other electronic systems.

BECOMING AN ELECTRICIAN

- Apprenticeship programs usually require 4 or 5 years of on-the-job training and related classroom instruction.
- This occupation requires licensing.
- Employers prefer apprentices with a high school education.
- Recommended secondary school courses include algebra and geometry, science, electricity, electronics, mechanical drawing, and fiber optics.

Apprentices Mike Scull and Mike Gault repair a parking lot light.

HEATING , VENTILATION, AIR CONDITIONING, AND REFRIGERATION TECHNICIAN

These skilled workers install, service, and repair many different types of heating, air-conditioning, and refrigeration equipment.

Working with a wide range of equipment requires HVAC installers/servicers to

- Δ **install** central air-conditioning and heating systems and refrigeration equipment according to blueprints and design specifications
- Δ **overhaul** compressors
- Δ **troubleshoot** electrical control circuits, including parts such as relays and thermostats
- Δ **adjust** air flow for proper distribution
- Δ **place** motors, compressors, condensing units, evaporators, and other components in location
- Δ **connect** equipment to the duct work and refrigerant lines
- Δ **diagnose** system problems
- Δ **observe** strict environmental standards regarding refrigerant handling.

Although many HVAC technicians work in residential or commercial construction, they can work anywhere there is a climate control system.

BECOMING AN HVAC TECHNICIAN

- Apprenticeship programs usually require 4 years of on-the-job training and related classroom instruction.
- This occupaiton requires licensing.
- Employers prefer applicants with a high school education.
- Secondary school courses in algebra, geometry, trigonometry, physics, mechanical drawing, electricity, and blueprint reading can be helpful to an apprentice.

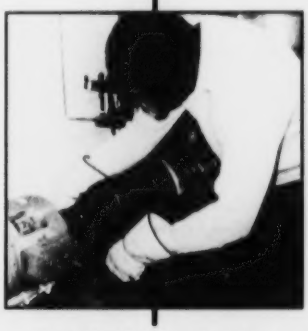
PLUMBER/PIPEFITTER

Plumbers assemble, install, and repair pipes, fittings, and fixtures of heating, water, and drainage systems according to specifications and plumbing codes. They usually work with pipes and related fixtures that are 4 inches in diameter or less.

Pipefitters lay out, fabricate, assemble, install, and maintain piping, piping systems, and equipment for steam, hot water, heating, cooling, lubricating, and industrial processing systems. They usually work with large pipes that are frequently secured by flanges or welds.

Their jobs demand that plumbers and pipefitters

- Δ **interpret** building plans and work drawings
- Δ **locate and mark** the position of pipes and pipe fittings
- Δ **cut, thread, and bend** pipes
- Δ **assemble and install** valves, pipe fittings, and pipes
- Δ **solder, braze, and weld** to join pipes
- Δ **fill** pipe systems with water or air
- Δ **determine** if system is leaking by reading pressure gauges
- Δ **install and repair** plumbing fixtures
- Δ **repair and maintain** plumbing.



Curtis Smith is learning about pumps in order to qualify as a plant area mechanic with pipefitting responsibilities.

BECOMING A PLUMBER OR PIPEFITTER

- Apprenticeship programs usually require 4 years of on-the-job training and related classroom instruction.
- This occupation requires licensing.
- Employers prefer applicants with a high school education.
- Recommended courses in high school include algebra, geometry, trigonometry, physics, metal shop, blueprint reading, and plumbing.

STRUCTURAL STEEL WORKER

Structural steel workers raise, place, and unite large beams, columns, and other structural steel members to form completed structures or frameworks. They work as members of a crew.

As part of a crew, structural steel workers

- Δ **set up** hoisting equipment for raising and placing steel members
- Δ **fasten** steel parts to the cables of hoisting equipment
- Δ **pull, push, or pry** steel parts into approximate position while the parts and workers are supported by hoisting devices
- Δ **force** steel parts into final position, using turnbuckles, crowbars, jacks, and hand tools
- Δ **align/position** rivet holes in steel parts and **drive** driftpins through holes
- Δ **measure** the vertical and horizontal position of steel parts with a plumb bob and level
- Δ **bolt** positioned steel parts to keep them in place until permanently riveted, bolted, or welded
- Δ **cut and weld** steel parts in making alterations
- Δ **reinforce** existing structures.

Kathy Ramos travels up and down the eastern seaboard, working as a structural ironworker.

BECOMING A STRUCTURAL STEEL WORKER

- Apprenticeship programs usually require 3 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Secondary school courses in algebra, geometry, mechanical drawing, blueprint reading, metal shop, and welding are helpful.

SURVEYOR TECHNICIAN (PARTY CHIEF)

Surveyor assistants and technicians assist surveyors by setting up surveying equipment and taking measurements of land areas for mapmaking, construction and engineering projects, mining, and other purposes. A party chief leads the work of the survey crew under the direction of a licensed land surveyor.

Survey party chiefs

- Δ **hold** level or stadia rod at designated points to determine elevations and distances
- Δ **call out** readings to survey party members
- Δ **write** station numbers and readings in notebooks
- Δ **mark** points of measurement with elevation, station number, or other identifying marks
- Δ **measure** distances between survey points, using steel or cloth tape or surveyor's chain
- Δ **place** stakes at designated points and drive them into the ground at specified elevations
- Δ **cut and clear** brush and trees from the line of survey
- Δ **supervise** surveyor assistants and helpers.

BECOMING A SURVEYOR PARTY CHIEF

- Surveyor party chief apprenticeships usually take 4 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Secondary school courses in drawing and design, earth science, algebra, trigonometry, and mechanical drawing are recommended.

Licensed surveyors usually obtain their basic training through civil engineering programs at universities or 4-year institutions.

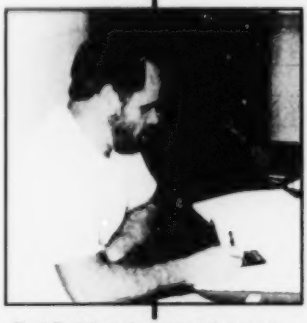
MECHANICS AND TECHNICIANS

This group of workers maintains instruments and machines by troubleshooting and diagnosing problems and by testing, repairing, moving, and maintaining equipment that includes automobiles, engines, heavy machines, and sophisticated electronic devices.

If you become an apprentice mechanic or technician, you may work in a research or testing laboratory, in a service or repair shop, on the production floor, or at a customer location. You may be a specialist such as a biomedical equipment technician or a generalist like a millwright or maintenance mechanic.

In Virginia, apprentices may work in the following occupational specialties:

Automobile Body Repairer
Automobile Mechanic
Biomedical Equipment Technician
Construction Equipment Mechanic
Diesel Mechanic
Electrical/Electronic Technician
Maintenance Mechanic
Millwright.



Earl Riddle is learning electronics, an essential area of knowledge for maintenance mechanics.

WORKING CONDITIONS

Working conditions vary according to the environment in which a mechanic or technician works. Mechanics generally work indoors in well lighted, well ventilated spaces, but the shop may be noisy and the parts dirty. They may have to stand or stoop in cramped or awkward positions to reach otherwise inaccessible parts. Construction equipment mechanics may work in the field because of the expense of moving heavy equipment to a shop.

Technicians who work with electronic equipment usually work in quieter, air-conditioned environments.

Mechanics and technicians generally work a standard 40-hour week, but overtime is fairly common. Those employed by a manufacturing firm may work shifts. The same is true of biomedical equipment technicians who maintain essential hospital equipment.

JOB OUTLOOK

The national employment outlook varies for mechanics and technicians.

A predicted increase in the number of cars on the road is good news for future automotive technicians.

- Rapid growth in computers and electronics means that technicians who work on sophisticated electrical, electronic, or computerized equipment will find plentiful opportunities, although those who work in defense-related jobs will experience some difficulty.
- Auto body repairers, auto mechanics, and diesel mechanics will find jobs because these fields are expanding; more automobiles are on the road, and more freight is being moved by truck.
- Apprentice maintenance mechanics, construction equipment mechanics, and millwrights will primarily replace retiring journey level workers.
- Employers often draw maintenance mechanics from existing employees, who compete for apprenticeships on the basis of seniority and aptitude.

EARNINGS

Nationally, the median wage for journey-level mechanics and technicians in 1990 ranged from $12.00 per hour for construction equipment and maintenance mechanics to $18.25 for auto body repairers.

Apprentices start at about 40 to 50 percent of the wage of journey-level workers and receive periodic raises until they reach full pay.

ADDITIONAL INFORMATION

If you want to know more about careers for mechanics and technicians and related apprenticeship opportunities, contact your local Virginia Employment Commission Job Services Office; the Virginia Department of Labor and Industry, Division of Apprenticeship Training; or the U.S. Department of Labor, Bureau of Apprenticeship and Training. (See page 59 for addresses and telephone numbers.)

Related instruction for apprentice maintenance mechanics Danny Cork (l) and Rodger Lee Turner (r) includes hands-on practice.

AUTO BODY REPAIRER

Auto body repairers fix damaged bodies and body parts of cars, trucks, buses, campers, and trailers.

To complete repairs, auto body repairers

- Δ **estimate** the cost of a repair job
- Δ **pound out** small dents with a hammer, pick hammer, or punch
- Δ **straighten** bent or twisted frames
- Δ **weld** metal parts
- Δ **remove** parts to gain access to vehicle body and fenders
- Δ **remove and repair or replace** damaged fenders, panels, doors, grills, glass, or other body parts
- Δ **fill** damaged areas with plastic body fillers
- Δ **fill, grind, sand, and smooth** filled or repaired surfaces
- Δ **refinish** by painting with primer coat, sanding, and painting with a finish coat or clear coat
- Δ **aim** headlights and **align** wheels
- Δ **recharge** air-conditioning system
- Δ **replace** pin-striping.

Did you know?

Technical repair manuals require college - level reading skills.

BECOMING AN AUTO BODY REPAIRER

- Apprenticeship programs for auto body repairers generally require 3 to 4 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Secondary school courses in auto body repair, drafting, general math, machine shop, and welding are helpful to potential apprentices.
- Good reading skills are essential because of the high level of instruction and diagrams in technical manuals.

AUTO MECHANIC

Automobile mechanics inspect, maintain, troubleshoot, diagnose, and repair mechanical and electrical parts of automobiles, trucks, and vans.

To accomplish a variety of tasks, auto mechanics may

- Δ **examine** vehicles and **discuss** with customers the nature and extent of damage or malfunction
- Δ **plan** work procedures, using charts, technical manuals, or computer systems
- Δ **raise** vehicles, using a hydraulic jack or hoist
- Δ **remove and disassemble** units such as engines, transmissions, and differentials
- Δ **repair, overhaul, or replace** parts such as pistons, rods, valves, carburetors, bearings, distributors, shock absorbers, or exhaust systems
- Δ **rewire** ignition systems, lights, and instrument panels
- Δ **reline and adjust** brakes
- Δ **align** front ends
- Δ **replace and adjust** headlights
- Δ **install and repair** accessories such as radios, heaters, and mirrors.

Auto mechanics must quickly absorb a steady stream of changes to complex diagnostic and troubleshooting information.

BECOMING AN AUTO MECHANIC

- It takes 3 to 4 years of on-the-job training and classroom instruction to become a journey level auto mechanic.
- Employers prefer applicants with a high school education.
- Apprentices find high school courses in auto mechanics, electricity and electronics, metal shop, shop math, and drafting to be helpful.
- The high level of reading required to use complex technical manuals or computerized diagnostics calls for advanced reading and comprehension skills.

BIOMEDICAL EQUIPMENT TECHNICIAN

Biomedical equipment technicians repair, calibrate, and maintain medical equipment and instrumentation used by physicians, nurses, laboratory technicians, and engineers to research, diagnose, monitor, or treat physical ailments or dysfunctions. They

- Δ **inspect and install** medical devices ranging from anesthesia equipment to patient-care computers
- Δ **service** medical equipment and instruments, using hand tools, power tools, measuring devices, troubleshooting techniques, and preventive maintenance schedules
- Δ **safety-test** medical equipment and health care facility structures to ensure patient and staff safety from electrical or mechanical hazards
- Δ **consult** with medical or research staff to ascertain that equipment functions properly and safely
- Δ **demonstrate and explain** correct operation of equipment
- Δ may **modify or develop** instruments or devices under supervision of medical or engineering staff.

Instrument technicians like Sara Kisling can specialize in biomedical equipment.

BECOMING A BIOMEDICAL EQUIPMENT TECHNICIAN

- An apprenticeship program generally takes 4 years of on-the-job training and related classroom instruction.
- Technicians in this field must work to a high degree of accuracy and detail.
- Employers prefer applicants with a high school education.
- Secondary courses in electronics and medical terminology and an interest in science and math are recommended.

CONSTRUCTION EQUIPMENT MECHANIC

Construction equipment mechanics analyze malfunctions and repair, rebuild, and maintain construction equipment such as cranes, power shovels, scrapers, paving machines, motor graders, trench-digging machines, conveyors, bulldozers, dredges, pumps, compressors, and pneumatic tools.

Working on a wide range of equipment, these mechanics may

- Δ **troubleshoot** engine problems and **analyze** hydraulic system complaints
- Δ **dismantle** the machine or some of its parts
- Δ **inspect** machinery for damage or wear and tear
- Δ **perform** preventive maintenance
- Δ **examine** clearance and dimensions, using gauges, calipers, and micrometers
- Δ **weld** broken parts and structural members
- Δ **replace** defective engines and subassemblies such as transmissions
- Δ **make** field overhauls and repairs in order to finish construction jobs
- Δ **test** repaired equipment to ensure proper working condition.

Welding, demonstrated here by apprentice Donald Coffey, is an integral part of repairing construcion equiment.

BECOMING A CONSTRUCTION EQUIPMENT MECHANIC

- Apprenticeship programs for construction equipment mechanics require 3 to 4 years of on-the-job training and classroom instruction.
- Employers look for applicants with a high school education, mechanical aptitude, and a knowledge of machinery.
- Secondary school courses in auto mechanics, diesel mechanics, machine shop, mechanical drawing, heavy duty equipment mechanics, and welding are helpful.

DIESEL MECHANIC

Diesel mechanics repair and maintain diesel engines used to power machines such as buses, ships, trucks, railroad trains, electric generators, and construction machinery, using hand tools, precision measuring instruments, and machine tools.

On the job, diesel mechanics may

- Δ **inspect and test** engines to locate causes of trouble
- Δ **disassemble** engines and **examine** parts for defects and excessive wear
- Δ **recondition and replace** parts such as pistons, bearings, gears, valves, and bushings
- Δ **weld and cut** parts, using arc welding and flame cutting equipment
- Δ **rebuild** engines
- Δ **repair** fuel injection systems, starting systems, and cylinder heads
- Δ **perform** preventive maintenance.

BECOMING A DIESEL MECHANIC

- Apprenticeship programs for diesel mechanics require 4 years of on-the-job training and classroom instruction.
- Employers look for applicants with mechanical aptitude and a knowledge of machinery.
- Employers prefer applicants with a high school education.
- Secondary school courses in auto mechanics, diesel mechanics, machine shop, mechanical drawing, electronics, and algebra are helpful.

Diesel engine maintenance requires skills in electronics, welding, and precision measurement.

ELECTRICAL/ELECTRONICS TECHNICIAN

Electrical and electronics technicians develop, manufacture, maintain, and service a wide variety of electrical and electronic equipment and components. They are sometimes referred to as *engineering technicians.*

Electrical technicians assemble, maintain, and test electrical equipment and components such as motor-controlled devices, switch panels, transformers, generator windings, and solenoids. **Electronics technicians** build, test, repair, and modify electronic equipment such as computers, communications equipment, industrial and medical measuring or control devices, and radar.

Electrical/electronics technicians

- Δ **discuss** assembly and layout problems with engineers
- Δ **draw** sketches to clarify design details and functional criteria of units
- Δ **assemble** circuitry or **complete** prototype model according to engineering instructions and technical manuals
- Δ **perform** preventive and corrective procedures
- Δ **set up** test equipment and wiring to conduct tests on the performance and reliability of products and equipment
- Δ **conduct** periodic tests
- Δ **analyze and interpret** test results
- Δ **diagnose** the cause of malfunctions
- Δ **recommend** changes in circuitry or specifications or replacement of equipment that fails to meet operating standards
- Δ **adjust and modify** parts and wiring and **record** effect on unit performance
- Δ **write** technical reports and **draw** charts and diagrams that show how the system operates.

James Hammer combined apprenticeship with community college courses to become an electronics technician.

(continued)

BECOMING AN ELECTRICAL/ ELECTRONICS TECHNICIAN

- Apprenticeships for electrical/electronics technicians usually take 3 to 4 years of on-the-job experience and related academic instruction.
- Employers prefer applicants with a high school education.
- Secondary courses in algebra, electricity and electronics, geometry, and robotics are recommended.
- Engineering technicians need aptitude for math and science. Those who work in design need to be creative and also must enjoy working on an engineering team. Technicians who work in the service field need good customer relations skills.

William Smith (l) and Ronald Hanger (r) are applying concepts and theories learned in electronics class.

MAINTENANCE MECHANIC

Maintenance mechanics repair and maintain machinery and mechanical equipment such as engines, motors, pneumatic tools, conveyor systems, and production machines and equipment in accordance with manuals and specifications.

To keep complex equipment operational, maintenance mechanics may

- Δ **locate** causes of trouble by observing mechanical devices in operation and listening to their sounds
- Δ **dismantle** devices to gain access to and remove defective parts, using hoists, cranes, hand tools, and power tools
- Δ **examine** form and texture of parts to detect imperfections
- Δ **inspect** used parts to determine changes in dimensional requirements
- Δ **adjust** functional parts of devices and control instruments
- Δ **repair or replace** defective parts
- Δ **install** special functional and structural parts in devices
- Δ **start** devices to test their performance
- Δ **lubricate and clean** parts
- Δ **set up and operate** lathe, drill press, grinder, and other metalworking tools to make and repair parts.

Richard Black is learning to maintain expensive electronic control equipment.

BECOMING A MAINTENANCE MECHANIC

- Apprenticeship programs for maintenance mechanics require 4 years of on-the-job training and classroom instruction.
- Employers prefer high school or vocational school graduates with courses in algebra, geometry, trigonometry, physics, mechanical drawing, technology education, electricity and electronics, heavy duty equipment mechanics, machine shop, and welding.

MILLWRIGHT

Millwrights are often called "jacks of all trades" because of the wide variety of duties and skills their jobs require. They install, repair, replace, and dismantle machinery and equipment in an industrial establishment according to layout plans, blueprints, and other drawings.

To accomplish this installation, millwrights

- Δ **determine** work procedures by reading blueprints and schematic drawings
- Δ **dismantle** machines
- Δ **move** machinery and equipment
- Δ **assemble and install** equipment such as shafting, conveyors, and tram rails
- Δ **construct** foundations for machines
- Δ **align, assemble, and secure** machinery to foundations
- Δ **repair, oil, and maintain** machinery and equipment.
- Δ **install, repair, and replace** mechanical, electrical, and electronic controls.

Millwrights must be strong and agile because their work generally requires a considerable amount of lifting and climbing.

BECOMING A MILLWRIGHT

- Apprenticeship programs usually require 4 years of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.
- Secondary school courses in algebra, geometry, trigonometry, physics, welding, drafting, technology education, machine shop, woodworking, and mechanical drawing are helpful.

SERVICE AND SUPPORT WORKERS

People who work in "service occupations" have direct contact with or perform services or sell products on order from the public. They must have highly developed skills in customer relations in order to fulfill their responsibilities. Service jobs can be very demanding but are rewarding to apprentices who practice the art of pleasing the customer.

Administrative support workers coordinate work and the flow of information to the staff or clients of a company. They too must have finely tuned skills in communication and human relations.

In Virginia, apprentices work in the following service occupations:

Baker
Barber
Cook/Chef
Cosmetologist
Dispensing Optician
Office Technician
Pharmacy Assistant.

Apprentice Regina Lowery received an award for her work from the Virginia Chefs Association.

WORKING CONDITIONS

Businesses that serve the public are open for the convenience of their customers. Therefore, service workers may work long hours, including evenings and weekends. They must stand for long periods of time.

Some restaurant kitchens are air-conditioned, but most are hot places to work. Barbers, cosmetologists, opticians, office technicians, and pharmacy assistants usually work in pleasant, well lighted, well ventilated surroundings. Safety and sanitation are important concerns to all these workers.

Donna Middleton is learning complex formulas for lens measurement.

JOB OUTLOOK

Plentiful job opportunities are predicted nationally through 2005 for people interested in working in service occupations. Consider these trends that will affect employment:

- The fastest growing segment of the population is middle-aged and elderly men and women.
- More women are in the workforce than ever before.
- People have more leisure time than any other time in history.

These trends translate into jobs within the service sector. As personal income and leisure time increase, people can afford and will seek all types of services. Demand for services related to health care, personal appearance, dining out, and recreational activities will increase.

For example, the demand for qualified opticians is much greater than the supply of applicants, making this a very rewarding career for apprentices with a strong aptitude for highly technical work. Full-service restaurants will offer plenty of opportunities for cooks, chefs, and bakers. Barbers will find the demand for their services increasing if they offer a variety of hairstyling services.

EARNINGS

The national median wage for journey-level service workers varies widely. In 1990, cooks and bakers earned an average of $6.50 per hour, but an executive chef earned more than $40,000.00 per year, or nearly $20.00 per hour. Dispensing opticians and office technicians earned a median hourly wage of $12.00. Barbers and cosmetologists make between $7.00 and $14.00 per hour, but some work on commission, keeping 50 to 70 percent of

money they take in. Barbers and cosmetologists also receive tips from satisfied customers. (No national wage information is available for pharmacy assistants.)

Apprentices start at about 40 to 50 percent of the wage of journey-level workers and receive periodic raises until they reach a full wage.

ADDITIONAL INFORMATION

If you want to know more about these service occupations and related apprenticeship opportunities, contact the local Virginia Employment Commission Job Services Office; the Virginia Department of Labor and Industry, Division of Apprenticeship Training; or the U.S. Department of Labor, Bureau of Apprenticeship and Training. See page 59 for addresses and telephone numbers.

Apprentices who learn electronics, such as Larry Breeden (seated), shown here with instructor Larry Long, can decide to enter a lucrative career in consumer electronics service.

BAKER

Bakers measure, mix, and bake ingredients according to recipes to make bread, pastries, and other baked goods for restaurants, institutions, and retail bakery shops. In some kitchens, bakers are called pastry chefs or pastry cooks.

Whether they specialize in one type of product or prepare all types of goods, bakers

- Δ **follow** sequential directions, both oral and written
- Δ **measure and weigh** ingredients
- Δ **dump** ingredients into mixing machines and **mix** them to specifications
- Δ **cook** ingredients in steam kettles
- Δ **roll, cut, and shape** dough to form a variety of products
- Δ **place** dough in pans, molds, or on sheets
- Δ **bake** dough in ovens or on grills
- Δ **observe** color of products being baked and **adjust** controls to maintain temperature, humidity, and baking time
- Δ **apply** glaze, icing, or other topping to baked goods
- Δ **create** decorative finishes and presentations of baked goods.
- Δ **keep** accounts and other records of production.

Cooks and bakers will find many job opportunities in the kitchens of nursing homes and residential care facilities for the elderly.

BECOMING A BAKER

- It takes 3 years of combined on-the-job training and classroom instruction to become a journey-level baker.
- Employers prefer applicants with a high school education.
- Secondary school courses in business math, catering, commercial foods, nutrition, and vocational home economics are helpful.

COOK/CHEF

Cooks prepare, season, and cook soups, meats, vegetables, desserts, and other foodstuffs for consumption in hotels and restaurants. They may also prepare food for people on special diets.

Chefs supervise, coordinate, and participate in activities of cooks and other kitchen personnel in preparing foods.

As part of their jobs, cooks and chefs

- Δ **plan** menus
- Δ **select, adapt, or create** recipes
- Δ **estimate** food requirements from the menu
- Δ **select and procure** foods and ingredients
- Δ **prepare** raw foods for cooking by washing, peeling, and cutting
- Δ **weigh, measure, and mix** ingredients according to recipes
- Δ **season** food
- Δ **regulate** the temperature of ovens, broilers, grills, and roasters
- Δ **observe and test** food being cooked
- Δ **carve and serve** portions on plates
- Δ **supervise** other cooks or kitchen helpers
- Δ **maintain** records and accounts.

Marco Shaw was preparing to attend graduate school in political science when he decided to become a chef apprentice instead.

BECOMING A COOK OR CHEF

- Programs offered by trade unions or professional associations require apprentice cooks and chefs to complete on-the-job training and classroom instruction ranging from a few months to 3 years.
- Employers prefer applicants with a high school education
- High school courses in business math, basic business, commercial foods, food science, and nutrition are beneficial.

BARBER

Barbers cut and trim hair to satisfy each customer's request or to suit the shape of the customer's head and current hair styles. They may

- Δ **cut, trim, and taper** hair
- Δ **dye, retouch, and bleach** hair
- Δ **style** hair
- Δ **straighten or curl** hair
- Δ **shape** the neckline and sideburns
- Δ **shave** facial and neck areas
- Δ **trim** beards
- Δ **apply** hairdressings and lotions
- Δ **massage** scalp, neck, and face
- Δ **advise** customers on hair and scalp care.

BECOMING A BARBER

- This occupation requires licensing. To become a licensed barber in Virginia, an applicant must be 17 years old and pass the state examination.
- To qualify for the examination, applicants must complete training from a licensed barber school, an Armed Forces program, a public school program, or an apprenticeship program approved by the Board of Barber Examiners.
- Apprenticeship programs generally require 18 months of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.

Barbering is an ancient occupation that is changing with today's focus on hairstyling.

COSMETOLOGIST

Cosmetologists provide beauty services to both male and female customers of all ages. They may

- Δ **analyze** hair to ascertain condition
- Δ **apply** bleach, dye, or tint to hair
- Δ **shampoo** hair and scalp
- Δ **massage** scalp, face, and neck
- Δ **apply** scalp-conditioning treatments for hygienic or remedial purposes
- Δ **style** hair by blowing, cutting, trimming, and tapering
- Δ **suggest** hair style according to physical feature of patron and current styles or **determine** patron preferences
- Δ **curl or straighten** hair
- Δ **apply** permanent wave solutions
- Δ **recommend** cosmetics for conditions such as dry or oily skin
- Δ **apply** lotions and creams to customer's face and neck
- Δ **shape and color** eyebrows or eyelashes
- Δ **clean, shape, and polish** fingernails and toenails
- Δ **maintain** records and accounts

BECOMING A COSMETOLOGIST

- This occupation requires licensing. A licensed cosmetologist in Virginia must graduate from a licensed public or proprietary school of cosmetology or complete an approved apprenticeship program and pass the state written and practical examination.
- Apprenticeship programs for cosmetologists generally require 18 months of on-the-job training and related classroom instruction.
- Employers prefer applicants with a high school education.

Cosmetologists must apply a number of concepts and principles of chemistry, anatomy, and physiology.

DISPENSING OPTICIAN

Dispensing opticians design, order, and adjust eyeglasses and contact lenses to people whose eyesight has been tested by a physician (ophthalmologist) or optometrist. They may

- Δ **analyze and interpret** a customer's written optical prescription to determine the lens specifications
- Δ **measure** the customer's facial features
- Δ **assist** the customer in selecting the style and color of frames and lenses
- Δ **prepare** a work order for fabrication and mounting of lenses
- Δ **verify** the exactness of finished lenses by checking the power and surface quality with special optical instruments
- Δ **adjust** finished eyeglasses to fit the customer
- Δ **instruct** customers in the use and care of eyeglasses and contact lenses
- Δ **fix** broken frames, **replace** temple screws, and **adjust and refit** glasses.

When they finish their apprenticeship, Arlinda Baylor (l) and Donna Middleton (r) will take the state licensing exam for dispensing optician.

BECOMING AN OPTICIAN

- This occupation requires licensing in Virginia. To become licensed, applicants must graduate from a postsecondary institution or complete an approved apprenticeship and pass the state examination.
- Apprenticeship programs require 3 years of combined on-the-job training and classroom instruction.
- Employers prefer applicants with a high school education.
- Secondary school courses in algebra, geometry, trigonometry, physics, mechanical drawing, and science will help apprentices succeed.

OFFICE TECHNICIAN

Office technicians schedule appointments, give information to callers, take and transcribe dictation, maintain files, and otherwise perform and assist other office personnel with clerical, administrative, and business duties.

Office technicians often supervise other office personnel and keep personnel records. They also

- Δ **read and route** incoming mail
- Δ **use** computer software packages such as WordPerfect, Lotus 1-2-3, and Harvard Graphics
- Δ **take** dictation by using shorthand or recording machine
- Δ **compose and type** statistical reports
- Δ **duplicate** correspondence and other materials
- Δ **file and retrieve** correspondence and other records
- Δ **answer and use** telephone systems
- Δ **schedule** appointments
- Δ **greet** visitors
- Δ **arrange** travel schedules.

Today's office technician must manage technology to exchange information and support a company's mission.

BECOMING AN OFFICE TECHNICIAN

- Apprenticeship programs offered through business and industry require 2 years of on-the-job training and related classroom instruction.
- Secondary courses in mathematics; computer operations; communication skills, including grammar, spelling, and punctuation; and typewriting/keyboarding are very beneficial.
- Employers prefer applicants with a high school education.

PHARMACY ASSISTANT

Pharmacy assistants mix and dispense prescribed medications and pharmaceutical preparations under the supervision of a licensed pharmacist. They

- Δ **compound** preparations according to prescriptions
- Δ **weigh or measure** dosages
- Δ **grind, heat, filter, or dissolve and mix** liquid or soluble drugs or chemicals
- Δ **fill** bottles with prescribed tablets or capsules
- Δ **type or print** labels for containers
- Δ **receive and store** incoming supplies
- Δ **count** stock and **enter** data in computer to keep inventory records
- Δ **process** records of medication and equipment issued to patients or customers
- Δ **compute** charges and enter data in computer
- Δ **help** customers place, pick up, and pay for prescriptions
- Δ **clean** equipment and glassware according to prescribed methods
- Δ **may prepare** intravenous packs, using sterile technique, under supervision of hospital pharmacist.

Pharmacy assistants must combine careful attention to detail with human relations skills to serve their customers.

BECOMING A PHARMACY ASSISTANT

- An apprenticeship program for pharmacy assistant generally takes 1 year of on-the-job training and related instruction.
- The work requires careful attention to detail as well as human relations skills.
- Employers prefer applicants with a high school education.
- Secondary school courses in math and chemistry are recommended.

IS APPRENTICESHIP FOR ME?

CAREER PLANNING

Ideally, career planning begins in elementary or middle school with opportunities to explore careers of all kinds. Unfortunately, some young people enter high school with little idea of their occupational interests, aptitudes, goals, or options.

WHY have a career goal?

It is a well known fact that the job market has changed drastically in recent years and continues to change at a rapid pace. A person may change careers five or six times and jobs ten times or more during his or her working life. Jobs that seem rewarding today may not even exist tomorrow. Despite these conditions, establishing a career goal early in life—at least by high school—is essential.

- A clear career goal, even if it is temporary, helps focus high school course and program choices. Otherwise, you may wander through the curriculum, graduating with neither skills for employment nor the prerequisites for college entrance.
- Having a career goal, along with the ability to express goals and objectives, impresses potential employers and those who select college applicants.
- Confusion about the future can cause you to expend a lot of energy. Once the decision is made to pursue a certain course of action, you can focus your energy into course work and other important activities.

Employers are not likely to hire, much less promote, people whose career goals are unformed or unclear.

John Beasley chose apprenticeship as his training option followng high school.

HOW can I determine occupational interests and aptitudes?

- ***Take a test.*** There are many interest inventories and aptitude tests available to high school students through the guidance department. Some may be taken on and scored by computer. Some school divisions have assessment centers to help students discover occupational interests and assess their related abilities.
- ***Ask people to describe their jobs.*** Parents, neighbors, vocational teachers, members of vocational advisory committees, and other adults are often eager to talk about their fields and the benefits and disadvantages of their jobs.
- ***Use Virginia VIEW.*** This computer database contains information about hundreds of occupations and related education/training requirements. It should be available through the guidance department.
- ***Visit local businesses.*** Some schools offer opportunities to shadow workers for a period of time or to work part-time in local businesses. Also, you can call or visit a company's personnel department and ask for information.
- ***Attend career fairs.*** Many schools have career fairs where local employers or workers describe their jobs and their businesses. Some of these target special audiences such as female students or those interested in a specific field such as health care or military service.

I've set my goal. WHAT are my options for occupational training?

- Public vocational education (high school or technical center)
- Noncollegiate postsecondary vocational education (proprietary school)
- Employer training program
- Federal employment and training program (JTPA, for example)
- Armed forces training
- Home study (correspondence school)

- Community or junior college
- Tech prep (coordinated high school/ community college or apprenticeship program)
- College or university
- Apprenticeship.

Your school counselor can help you explore these options and make an informed decision.

APPRENTICESHIP AS A CHOSEN TRAINING OPTION

If you are interested in apprenticeship, you should learn more about the availability of and requirements for entry into specific programs. This will help you choose the appropriate academic and vocational courses to ensure success. If you are a high school student, your primary source of information should be your school counselor, who can help you contact the local Virginia Employment Commission (VEC) Job Services Office.

HOW can the VEC help me?

To use the services of the VEC Jobs Services Office, call for an appointment for a personal interview.

- When you arrive, complete the application, which is entered into a computerized system.
- You may want to view a video that explains apprenticeship and related instruction and highlights some specific occupations.
- During the interview, you will have a chance to discuss specific career choices or explore possibilities. You may take an interest inventory to help determine occupations that appeal to you.

Mark Kimmel, executive chef: "I was college trained but I now recommend apprenticeship. It provides more practical skills and is much less expensive than college."

Apprentice Douglas Fleming is taking part in a revolution in printing, a career that promises to be rewarding and challenging.

Once you have made a choice of occupation, you are ready to begin the process of becoming an apprentice.

- Each VEC office has a computer system that lists all job openings submitted by employers. You will have access to the list at any VEC Job Services office. Also, employers who need apprentices contact the VEC Apprenticeship Coordinator to request referral of good candidates.
- The VEC counselor will refer you to one or more employers. It is up to you to "sell" yourself to the employer through application and interview.
- When you are hired, you will sign an agreement of apprenticeship with your employer. You will agree to learn specified skills on the job and to attend classes outside working hours. The employer will agree to provide the training and to pay you according to a specified scale. You will be registered with the Department of Labor and Industry (DLI), Division of Apprenticeship Training.

WHAT IF I'm already employed?

If you already have a job in an occupation that is apprenticeable, you can ask your employer to consider starting an apprenticeship program. If the company agrees, a representative of the DLI will review the program and officially register it. You will be registered with the DLI at the same time.

WHERE can I get more information?

- Local Job Services Office of the Virginia Employment Commission (ask for the Apprenticeship Information Coordinator)

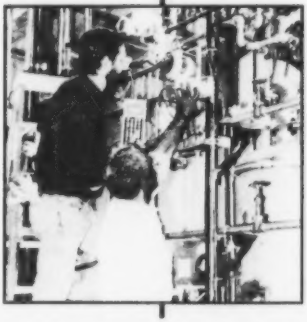
- Virginia Employment Commission
  Apprenticeship and Workforce
  Information Centers
  - Δ Northern Virginia:
    Sudley North Business Center
    7864 Donegan Drive
    Manassas, VA 22110
    (703) 361-1126
  - Δ Central Virginia:
    6707 Warwick Road
    Richmond, VA 23225
    (804) 674-3702
  - Δ Tidewater Virginia:
    6012 Jefferson Avenue
    Drawer J
    Newport News, VA 23605
    (804) 247-2080
  - Δ Roanoke Area:
    1202 Franklin Road, SW
    Roaonke, VA 24016
    (703) 857-7146

- Virginia Department of Labor and Industry
  Division of Apprenticeship Training

Abingdon	(703) 676-5465
Danville	(804) 836-8412
Fairfax	(703) 691-0351
Lynchburg	(804) 386-4705
Norfolk	(804) 858-6700
Richmond	(804) 786-2381
Roanoke	(703) 562-3580
Stuarts Draft	(703) 337-3225

- Virginia Department of Labor and Industry
  Apprenticeship Related Instruction
  Powers Taylor Building
  13 South Thirteenth Street
  Richmond, VA 23219
  (804) 371-0295

- U.S. Department of Labor
  Bureau of Apprenticeship and Training
  Room 10-020
  400 North Eighth Street
  Richmond, VA 23240
  (804) 771-2488



Sterling Durrett, apprenticeshp instuctor (r), shown here with apprentice Calvin Hughes: "The secret to job success is versatility. Otherwise, technology will pass you by."

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